

What is claimed is:

1. A substrate processing method comprising the steps of:
  - (i) supplying a chemical liquid on a rotating substrate to form a film of the chemical liquid on a surface of the substrate;
  - (ii) supplying a rinse liquid on the rotating substrate to form a film of a mixture of the chemical liquid and the rinse liquid on the surface of the substrate entirely; and
  - (iii) removing the mixture from the surface of the substrate by the rinse liquid.
2. The method according to claim 1, wherein:
  - the step (i) is performed by moving a chemical liquid nozzle discharging the chemical liquid from a first position above a periphery of the substrate toward a second position above a center of the substrate; and
  - the step (ii) is performed by moving a rinse liquid nozzle discharging the rinse liquid to follow the chemical liquid nozzle discharging the chemical liquid and moving from the first position toward the second position.
3. The method according to claim 2, wherein, in the step (ii), the rinse liquid nozzle follows the chemical liquid nozzle while maintaining a distance between the nozzles within a predetermined range ensuring that the rinse liquid is mixed with the chemical liquid before the film of the chemical liquid spreading radially outward breaks into droplets.
4. The method according to claim 1, wherein the step (iii) is performed by supplying the rinse liquid, and a rinse liquid supplying rate in the step (iii) is greater than that in the step (ii).
5. The method according to claim 2,
  - wherein the step (ii) includes the steps of:
    - stopping supplying the chemical liquid when the chemical liquid nozzle reaches the second position above the center of the substrate,
    - moving the rinse liquid nozzle toward the center of the substrate,

while continuing discharging the rinse liquid from the rinse liquid nozzle, and

wherein the step (iii) includes the steps of:

continuing supplying the rinse liquid from the rinse liquid nozzle while the rinse liquid nozzle being positioned above the center of the substrate; and

increasing a rotation speed of the substrate.

6. The method according to claim 5, wherein a rinse liquid supplying rate in the step (iii) is greater than that in the step (ii).

7. The method according to claim 1, wherein

the step (i) is performed by discharging the chemical liquid from a chemical liquid nozzle located above a center of the substrate; and

the step (ii) is performed by discharging the rinse liquid from a rinse liquid nozzle surrounding the chemical liquid nozzle and located above the center of the substrate.

8. The method according to claim 7, wherein, in the step (ii), the chemical liquid nozzle continues discharging the chemical liquid.

9. A substrate processing apparatus comprising:

a spin chuck adapted to hold and rotate a substrate;

a motor adapted to drive the spin chuck for rotation;

a chemical liquid nozzle adapted to supply a chemical liquid onto the substrate held by the spin chuck;

a rinse liquid nozzle adapted to supply a rinse liquid onto the substrate held by the spin chuck;

a nozzle moving mechanism adapted to move the chemical liquid nozzle and the rinse liquid nozzle relative to the substrate held by the spin chuck;

a chemical liquid control valve adapted to control a supply of the chemical liquid to the chemical liquid nozzle;

a rinse liquid control valve adapted to control a supply of the rinse liquid to the rinse liquid nozzle; and

a controller that controls the motor, the chemical liquid control

valve, the rinse liquid control valve and the nozzle moving mechanism according to a predetermined sequence of operations, the operations including:

(i) moving the nozzles, by operating the nozzle moving mechanism, from a first position above a periphery of the substrate toward a second position above a center of the substrate in such a manner that the rinse liquid nozzle follows the chemical liquid nozzle, while rotating the substrate held by the spin chuck by operating the motor, and while supplying the chemical liquid from the chemical liquid nozzle by operating the chemical liquid control valve, and supplying the rinse liquid from the rinse liquid nozzle by operating the rinse liquid control valve; and

(ii) stopping supplying the chemical liquid from the chemical liquid nozzle by operating the chemical liquid control valve when the chemical liquid nozzle reaches the second position above the center of the substrate, while continuing rotating the substrate, and continuing supplying the rinse liquid from the rinse liquid nozzle positioned above the center of the substrate.

10. The apparatus according to claim 9, wherein, in the operation (ii), a rinse liquid supply rate is increased by adjusting an opening of the rinse liquid control valve.

11. The apparatus according to claim 9, wherein the nozzle moving mechanism includes a nozzle arm, to which both the chemical liquid nozzle and the rinse liquid nozzle are mounted in such a manner that the rinse liquid nozzle is located outside the chemical liquid nozzle with respect to a radial direction of the substrate when the nozzles are located above the substrate held by the spin chuck.

12. The apparatus according to claim 9, wherein the nozzle moving mechanism includes a pair of nozzle arms, to which the chemical liquid nozzle and the rinse liquid nozzle are mounted, respectively.

13. The apparatus according to claim 12, wherein the controller is configured to control the nozzle moving mechanism in the operation (ii)

so that a distance between the chemical liquid nozzle and the rinse liquid nozzle is maintained within a range ensuring that the rinse liquid is mixed with the chemical liquid spreading radially outward in a form of a film before the film breaks into droplets.

14. A substrate processing apparatus comprising:
  - a spin chuck adapted to hold and rotate a substrate;
  - a motor adapted to drive the spin chuck for rotation;
  - a chemical liquid nozzle adapted to supply a chemical liquid onto the substrate held by the spin chuck;
  - a rinse liquid nozzle adapted to supply a rinse liquid onto the substrate held by the spin chuck;
  - a nozzle moving mechanism adapted to move the chemical liquid nozzle and the rinse liquid nozzle relative to the substrate held by the spin chuck;
  - a chemical liquid control valve adapted to control a supply of the chemical liquid to the chemical liquid nozzle; and
  - a rinse liquid control valve adapted to control a supply of the rinse liquid to the rinse liquid nozzle;wherein the chemical liquid nozzle and the rinse liquid nozzle comprise an inner tube and an outer tube, the inner tube serving as the chemical liquid nozzle, and the outer tube surrounding the inner tube to define an annular gap, serving as a liquid passage for the rinse liquid nozzle, between the tubes.
15. The apparatus according to claim 14, wherein a tip of the outer tube is positioned lower than a tip of the inner tube.
16. The apparatus according to claim 14, wherein a tip portion of the inner tube is tapered toward a tip of the inner tube.
17. The apparatus according to claim 14, further comprising a controller that controls the chemical liquid control valve and the rinse liquid control valve according to a predetermined sequence of operations, the operations including:
  - (i) supplying the chemical liquid from the chemical liquid nozzle

by operating the chemical liquid control valve, without supplying the rinse liquid;

(ii) thereafter, concurrently supplying the chemical liquid and the rinse liquid from the chemical liquid nozzle and the rinse liquid nozzle, respectively, by operating at least the rinse liquid control valve; and

(iii) thereafter, stopping supplying the chemical liquid nozzle while continuing supplying the rinse liquid, by operating at least the chemical liquid control valve.